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18. SUPPLEMENTARY NOTES

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The view, opinions, and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other documentation.

19. KEY WORDS (Continue on tweeter side if necessary and identity by DIOCK number)

Vibrational Energy Transfer

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

See attached

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FINAL REPORT

ARO PROPOSAL NUMBER:

RDRD-P-12224

PERIOD COVERED BY REPORT:

August 15, 1977 - March 31, 1981

TITLE OF PROPOSAL:

Laser Studies of Molecular

Collision Processes

CONTRACT OR GRANT NUMBER:

DAAG26-77-G-0200

NAME OF INSTITUTION:

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PRINCIPAL INVESTIGATOR:

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I. Statement of Problem:

The purpose of this research has been to determine the effect of selective electronic and vibrational excitation on energy transfer and reaction rates in simple molecular systems.

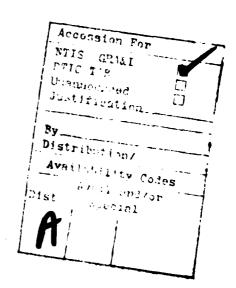
II. Principal Results:

A wide variety of behavior is exhibited in the competition between reaction and energy transfer for simple molecular systems. The principal results can be grouped into 3 categories.

The competition between relaxation and reaction in collisions of a highly vibrationally excited diatomic with thermal molecules has been studied. The observation of multiquantum energy transfer upon collision infers the occurrence of a reaction. In studies of HF(v = 4) with a variety of collision partners, removal of the initially excited species is seen to occur via single quantum energy transfer implying that the relaxation channel dominates.

- Studies of vibrational relaxation pathways have been extended to the CH₄, NH₃, H₂O, D₂O, H₂Se, D₂S systems. It is shown that systems which interact via hydrogen bonding show increased V + T, R rates with negative temperature dependence near room temperature. The enhanced V + T, R rates and negative temperature dependence can be explained with a model in which orbiting collisions are most effective in causing relaxation.
 - The vibrational Relaxation in Condensed Media.

 The vibrational spectroscopy and dynamics of matrix isolated HCl and CH₃F have been studied. At the cryogenic temperatures of these experiments, the attractive part of the intermolecular guest-host potential is seen to play an increasingly important role in causing vibrational relaxation. For those systems in which the attractive forces are known to be strong, as evidenced by the existence of van-der-Waals molecules in the gas phase, i.e. HCl-rare gas, relaxation rates correlate well with increasing intermolecular well depth. In all systems studied, there is a marked dependence of relaxation rates on host, spanning two orders of magnitude between Ar and Xe.



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